Silicon Management

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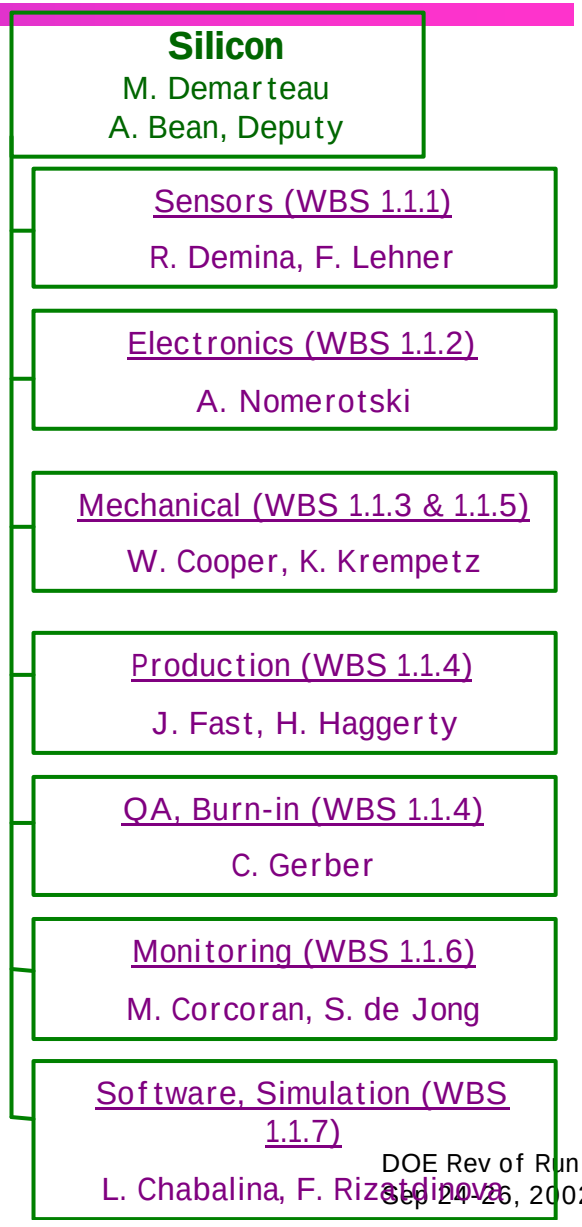
Outline

- Organization and Management
- Schedule
- Resources
- Conclusions

Organization

- Seven distinct Level 3 groups within the project each with its own L3 managers
- Management
  - Silicon group as a whole meets bi-weekly
  - Silicon L2 and L3 managers meet bi-weekly
- Subgroups
  - In addition many subgroups meet regularly
- We've built a strong collaboration with major participation from various university groups with clearly delineated responsibilities.



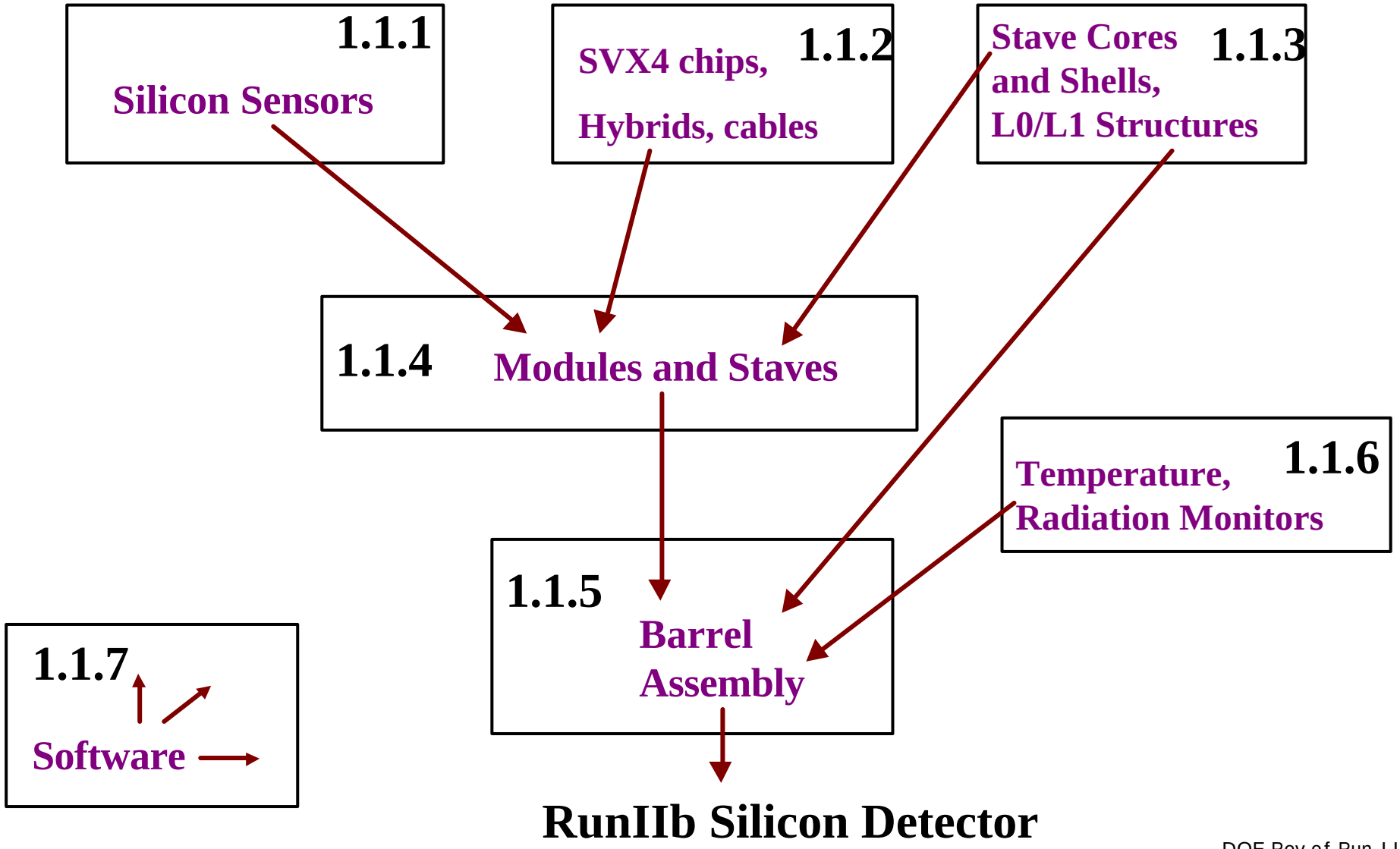
University Contributions

- **Sensor Testing**
  - KSU, SUNY StonyBrook, CINVESTAV, Moscow State Univ
- **Readout Electronics**
  - KSU, Kansas, UIC, Fresno State, Brown, Louisiana Tech, Northwestern, Zurich
- **Mechanical Design and Fabrication**
  - Univ. of Washington, Michigan State Univ.
- **Monitoring**
  - NIKHEF, Rice Univ.

These groups are ready to begin the project.

Every group has tasks assigned to them and are ready to go.

Production Line



Schedule Overview

- Relies on RunIIa experience
  - ♦ Build up unparalleled infrastructure and expertise at SiDet
  - ♦ Significant experience with Carbon Fiber at Lab 3
  - ♦ Some new elements similar to systems employed in RunIIa
    - »Digital jumper cables versus low mass cables in RunIIa
  - ♦ Some elements retained from RunIIa
    - »All of the downstream readout electronics
      - ✻ Interface boards, sequencers, VRB's, VTM's ,HV system
- Schedule is an honest estimate of time evolution of the project
- Schedule recognizes that there is pressure to stay on track

Example Task

10/10 Axial Module Production – WBS 1.1.4.14.2.2

WBS	Task Name	Duration	Start	Finish	Predecessors	M&S Cost $	Resource Names
1.1.4.14	**10/10 Axial Modules**	**92.84 w**	**Fri 12/13/02**	**Wed 10/27/04**		**$1,540.00**	
1.1.4.14.1	Develop electrical module preproduction	8 w	Fri 12/13/02	Tue 2/18/03	78SS+2 w,203SS+2	$130.00	PhysicistF,MechTe
1.1.4.14.2	**South**	**18.2 w**	**Tue 3/16/04**	**Fri 7/23/04**		**$705.00**	
1.1.4.14.2.1	**L2-5 (10/10 South Axial) Silicon Module Produ**	**0 w**	**Tue 3/16/04**	**Tue 3/16/04**	**681SS**	**$0.00**	
1.1.4.14.2.2	Align and glue sensors to hybrid	12 w	Tue 3/16/04	Wed 6/9/04	678,224SS+31%,582	$705.00	PhysicistF[25%],C
1.1.4.14.2.3	Wirebond sensors to hybrid	12 w	Mon 3/22/04	Tue 6/15/04	681SS+4 d,628	$0.00	WirebondingMach
1.1.4.14.2.4	**10/10 South Axial Silicon Module Production (**	**0 w**	**Tue 6/15/04**	**Tue 6/15/04**	**682**	**$0.00**	
1.1.4.14.2.5	Debug sensor module	12 w	Wed 3/24/04	Thu 6/17/04	682SS+2 d,357	$0.00	PostDoc[50%],Ele
1.1.4.14.2.6	Burn-in sensor modules	12 w	Wed 3/31/04	Thu 6/24/04	684SS+1 w	$0.00	Student[20%],Moc
1.1.4.14.2.7	Evaluate and repair sensor modules	12 w	Wed 4/14/04	Fri 7/9/04	685SS+2 w	$0.00	ElecTechSF[10%]
1.1.4.14.2.8	Perform quality assurance tests	12 w	Wed 4/28/04	Fri 7/23/04	686SS+2 w	$0.00	PostDoc[50%],SA
1.1.4.14.2.9	**10/10 South Axial Silicon Module Testing Con**	**0 w**	**Fri 7/23/04**	**Fri 7/23/04**	**687**	**$0.00**	

WBS Definition- On CMM, using fixtures align sensors and hybrid and glue all together

M&S BOE- Epoxy cost based on one 10cc mix per day with an anticipated cost of $1500 for 20 liters of epoxy, including purity testing. In addition there will be 1 packet of silver epoxy used per day throughout this production, at $11 each. Total epoxy cost is $11.75/day.

Labor BOE-There are 168 staves and thus 168 10-10 axial modules in the detector, which means 84 modules per north and south barrel. Including 20% spares, a total of 100 modules will have to be produced.

We foresee building 2 modules per day on one CMM. All modules can be produced in 10 weeks. To adequately train people and setup the procedures we expect that only one module will be built per day in the first week. One week is added to accommodate possible delays in part arrivals, equipment downtime or mishaps during production. Production of a module, based on 2a experience, should take 1 hour of time for each of a mechanical technician and a CMM technician. The mechanical technician helps setting up and does the documentation and database entry. The following day a mechanical technician flips the module and makes the HV and ground connections and installs HV insulation and updates documentation. The latter operation will take 1 hour per module. A mechanical technician is thus assigned at the 50% level and a CMM operator at the 25% level. A senior Fermilab physicist oversees the production at 25%.

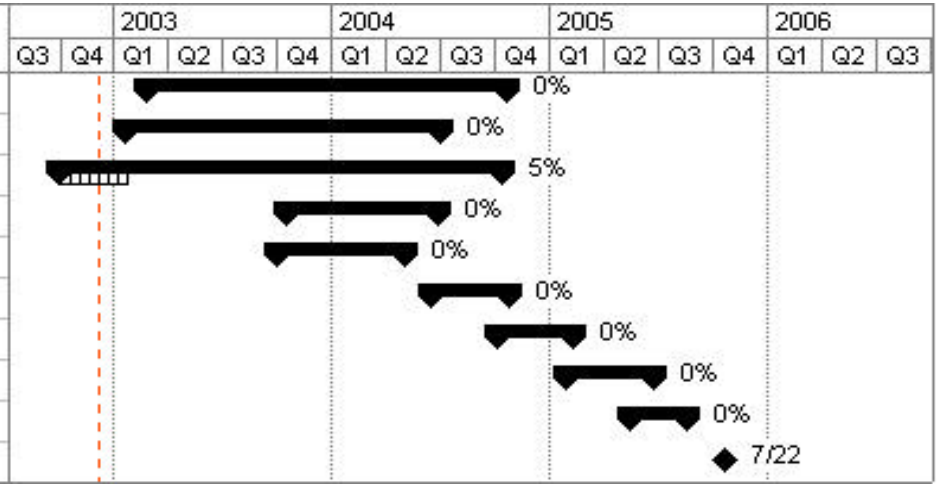
Included in all tasks!

Schedule highlights

Production Run and Testing

- SVX4 chip — 5/21/03-4/2/04
- L2-L5 Sensor — 2/12/03-7/20/04
- L2-L5 Hybrid — 7/16/03-7/12/04
- L2-L5 Module — 3/16/04-11/9/04
- Stave Assembly — 7/23/04-3/25/05
- Barrel Assembly with staves — 2/25/05-7/5/05

ID	Task Name
85	Fermilab Production L2-L5 Sensor Tasks
112	SVX4 Production Tasks
215	L2-L5 Hybrid Production and design
556	Stave Core Production
660	Fabricate 20cm Gangs
679	10/10 Axial Module Production
758	North 20/20 Stereo Module production
800	North Stave Assembly
902	North L2-L5 Barrel Assembly
914	Silicon Ready To Move To DAB



◆ Silicon Ready to Move to DAB — 7/22/05

Critical Path

SVX4 chip drives the critical path.

↓ NOW!

L2-L5 hybrids

↓ 11/02 – 7/04

L2-L5 Module Assembly

↓ 3/04 - 7/04

Stave Assembly

↓ 7/04 - 3/05

Barrel Assembly

3/05 – 7/05

Sensitivity (long)

Description	additional duration (wks)	End Date	Shift(wks)
Nominal Schedule		**22-Jul-05**	
Third SVX4 prototype	34	3-Apr-06	36
Third L2-5 Hybrid prototype	28	8-Dec-05	20
Third Analog Cable prototype	24	22-Jul-05	0
Second Digital Cable prototype	32	22-Jul-05	0
Second Junction Card prototype	16	22-Jul-05	0
Third Twisted Pair prototype	40	22-Jul-05	0
Third Adapter Card prototype	30	22-Jul-05	0
Third Purple Card prototype	20	22-Jul-05	0
Fabrication L0 South structure	20	22-Jul-05	0
L0 North+South sensor mounting	10 (each)	5-Oct-05	11
Fabrication L1 South structure	16	3-Aug-05	2
L1 North+South sensor mounting	10 (each)	17-Aug-05	4
HPK Production Loss of 600 sensors	12	30-Aug-05	6
All of the above		17-Aug-06	55

Sensitivity (short)

Task	Description	reduction in duration (wks)	End Date	Shift (wks)
	Nominal Schedule		22-Jul-05	
89	No second SVX4 prototype	-34	11-Jul-05	-1.5
156	No second L2-5 Hybrid prototype	-28	18-Jul-05	-1
252	No second Twisted Pair prototype	-40	22-Jul-05	0
266	No second Adapter Card prototype	-30	22-Jul-05	0
76	Production gain at HPK (600 sensors)	-12	22-Jul-05	0
	All of the above		8-Jul-05	-2

Other Mitigations possible to compress schedule:

- Staves: Can start mounting modules onto staves before all modules are complete (Save ~1 Month)
- SVX4 chips: Try and reduce testing time from 29 weeks, this also reduces hybrid stuffing time (potentially save 2 months)
- L2-L5 Sensors: Don't delay production sensor order from preproduction receipt (Save 3 months not on critical path)

Milestones

- There are 134 Milestones listed throughout the project that we are managing to
- We have completed two Milestones:
  - Readout of hybrid using SASEQ teststand 8/1/02
  - Release of silicon reconstruction code 9/21/01

WBS L3 Tasks	# of L2 milestones
1.1.1 Sensors	15
1.1.2 Readout	41
1.1.3 Mech Des.	9
1.1.4 Production	46
1.1.5 Barrel Ass.	14
1.1.6 Monitoring	3
1.1.7 Software	6

Cost Estimate

- Approach used for Cost Estimate
  - Strongly relies on RunIIa experience
  - Quotes are used wherever possible
  - University labor is included in the M&S costs
- Contingency follows general "project" guidelines unless noted in the basis of estimate - we have 55% on M&S
  53% on FNAL labor

Costs

- In FY02$ with no indirect cost
- Costs are in kilo$

WBS	Name	M&S	M&S cont.	FNAL labor	Labor cont	Total by WBS
1.1.1	Sensors	2,506	1,061	51	27	3,645
1.1.2	Readout	4,229	2,598	1,191	503	8,521
1.1.3	Mech Des	649	399	524	389	1,961
1.1.4	Prod	184	155	851	594	1,784
1.1.5	Assembly	384	171	1,100	469	2,124
1.1.6	Monitoring	55	28	32	16	131
1.1.7	Software	15	0	0	0	15
1.1.8	Admin	166	75	160	80	481
	TOTAL	**8,188**	**4,487**	**3,909**	**2,078**	**18,662**

M&S Cost Drivers

- **Sensors**
  - Production costs per sensor:
  - L0 $275
  - L1 $435
  - L2-L5 $510 Production TOTAL $1.8M
- **SVX4 chips $1.0M**
- **Hybrids $0.8M**
- **Cables**
  - Analog $183K
  - Digital Jumper $366K
  - Twisted Pair $327K TOTAL $0.9M

Costs are in FY02 $ with no contingency or indirect costs

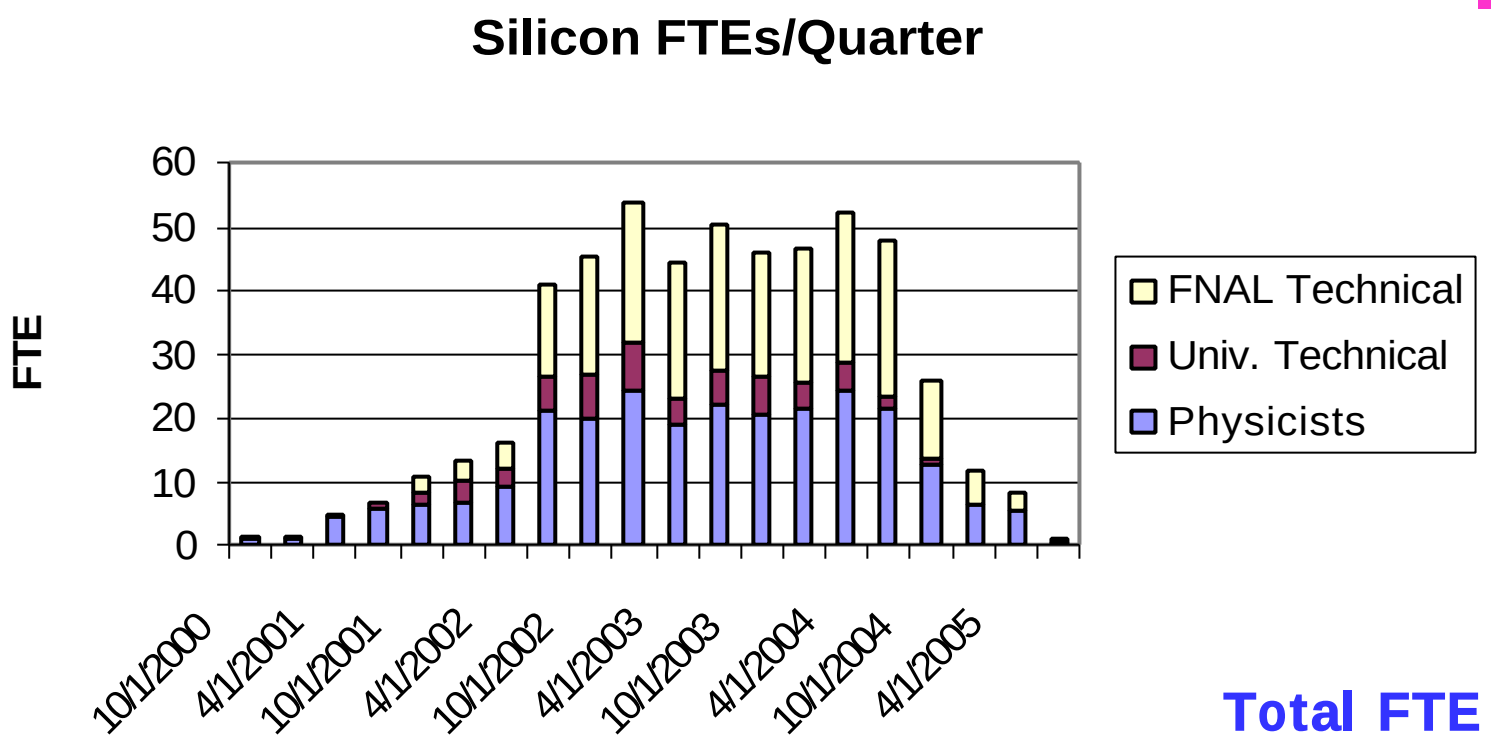
Near Term Large Purchases

- **11/18/02 SVX4 Preprod. Chips ($158K)**
  - These are on the critical path! Any delay, linearly delays the project.
  - Purchasing procedure exercised with prototypes, sole-source with TSMC hand-in-hand with procurement
- **2/12/03 L2-L5 Sensors (Total $1.5M)**
  - Sole source order with HPK, Preproduction order out 8/02 with specs in place, quotes in place
  - Procurement is working hand-in-hand with project
  - Delay of 2 weeks will delay the project end date
  - Sensors delivered over 64 weeks with 4 equal payments spread out over that time in schedule.

Equipment Purchases above $100K

Item	Cost (Kilo $)	Production Start Date
SVX4 Preproduction chip	158	11/18/02
L2-L5 Sensors	1,453	2/12/03
L2-L5 Digital Jumper Cables	263	4/3/03
L0 Sensors	161	4/17/03
L1 Sensors	155	4/17/03
SVX4 Production Chips	475	5/21/03
Analog Cables	167	7/3/03
L2-L5 Production Hybrids	382	7/16/03
Twisted Pair Cables	256	4/26/04

Labor Hours and Profile



		Total FTE years
• Physicists	112 khours	63
• Univ. Technical	25 khours	14
• FNAL technical	96 khours	54
• TOTAL	233 khours	131

Conclusions

- Management structure with 7, L3 groups
- Resource loaded schedule constructed using experience from RunIIa
- Silicon Ready to move to DAB 7/22/05
- Silicon Project cost in FY02$ with no indirect: $12.1M + $6.6M in contingency
- Number of FTE years needed: 131

  - We're ready to build the detector!
  - We have a project plan that specifies the schedule and cost which we can meet!